Multi-functional Composites: A Study in Silicone

Noa Lachman

Department of Materials Science and Engineering, Tel-Aviv University, Ramat Aviv, Tel Aviv 6997801, E-mail: noala@tauex.tau.ac.il, web: http://www.eng.tau.ac.il/~noala

Abstract

Multi-functional materials are materials with specific properties allowing them to perform multiple functions within their system. Such "smart" materials can be designed to preform multiple tasks and even change their properties in response to external stimuli. Here we focus on the manufacturing and characteristics of a multifunctional silicone rubber (VMQ-Vinyl Methyl Silicone rubber), as a soft conductive rubber. Silicone rubber has excellent properties including nontoxicity, biocompatibility, flexibility, low cost, and ease of fabrication. However, silicone is naturally an insulator, and conductive fillers usually reduce tensile strength, shear strength, softness, and most importantly –elasticity. We thus apply industrial procedures to make conductive silicone rubber using carbon nanotubes (CNT). We found that VMQ with as little as 4%wt of CNT is softer (45 Shore A) compared to the silver or carbon black reinforced VMQ (60-70 Shore A), conductive enough to satisfy the anti-static requirements (up to 100 Ω-cm) and almost as elastic as pure rubber (20%-30% compression set). Moreover, the addition of CNT allows for tension measurement using resultant changes in conductivity, as well as structural integrity degradation using Raman spectroscopy. The morphological origins of the superior electrical and mechanical behavior will also be discussed.

Short Biography

Dr. Noa Lachman is a new member in the department of materials science and engineering, previously a postdoctoral Associate at the department of Aeronautics and Astronautics at MIT. She received a B.S. (2003) in Chemistry and Physics from the Hebrew University in Jerusalem, Israel, and completed her Ph.D. work (2010) at the Weizmann Institute of Science, in the department of Materials and Interfaces. Her research with Prof. Wardle at MIT focused on tailoring and imaging of VA-CNT based composites for various applications, including energy storage and multi-functional structure materials. Dr. Lachman uses experimental techniques to obtain knowledge of nano-structure effect on mechanical and functional properties of these new materials, and she aims to develop a structure-function dataset which will enable the design of new materials with improved efficiency and performance. Dr. Lachman has authored and co-authored 20 journal articles, which have been cited together more than 500 times.